

Remarks

Reconsideration of this Application is respectfully requested.

Upon entry of the foregoing amendment claims 3-13, 16-18, 20-32, and 35-68 are pending in the application, with 18, 38 and 60 being the independent claims. Claims 1, 2, 14, 15, 19, 33, and 34 are sought to be cancelled without prejudice to or disclaimer of the subject matter therein. New claims 38 - 68 are sought to be added. These changes are believed to introduce no new matter, and their entry is respectfully requested.

Based on the above amendment and the following remarks, Applicants respectfully request that the Examiner reconsider all outstanding objections and rejections and that they be withdrawn.

Election

Reconsideration of the Requirement for Restriction is respectfully requested. Claims 3-13, 16-18, 20-32, and 35-68 are pending in this application. The Examiner has asserted that these claims are directed to two distinct inventions. These include:

Group I (claims 3-13, 16, 17, 38-68), drawn to a ball grid array package, classified in class 257, subclass 738.

Group II (claims 18-37), drawn to the method of assembling a ball grid array package, classified in class 438, subclass 1+. (See Office Action at paragraph 2).

The Examiner has required restriction to one of these claim groups.

Applicants have elected to prosecute claims 3-13, 16, 17, and 38-68 related to Group I. This election of claims is made with traverse. Applicants respectfully submit that the claims should not be restricted between Groups I and II, and that claims of Groups I and II should properly be included in a single patent application.

Independent claim 38 is representative of Group I. Claim 38 is directed to a ball grid array package and reads as follows:

38. (New) A ball grid array (BGA) package, comprising:

a substrate having a plurality of contact pads on a first surface electrically connected through said substrate to a plurality of solder ball pads on a second surface of said substrate;

a heat spreader that has a first surface and a second surface, wherein said first surface of said heat spreader is attached to said second surface of said substrate; and

a ring shaped stiffener being centrally open in a first surface and a second surface, wherein said first surface of said ring shaped stiffener is attached to said first surface of said substrate;

wherein said second surface of said heat spreader is capable of being coupled to a printed circuit board (PCB).

Independent claim 18 is representative of Group II. Claim 18 is directed to a method of assembling a ball grid array package and reads as follows:

18. (Amended) A method of assembling a ball grid array (BGA) package, comprising the steps of:

receiving a substrate having a plurality of contact pads on a first surface electrically connected through the substrate to a plurality of solder ball pads on a second surface of the substrate;

attaching a first surface of a heat spreader to the second substrate surface;

attaching a ring shaped stiffener that is centrally open in a first surface and a second surface to the first surface of the substrate;

configuring a second surface of the heat spreader to be coupled to a printed circuit board (PCB); and

attaching a plurality of solder balls to the second substrate surface.

Thus, these two claims are directed essentially to the same inventive concept. The Examiner concedes that "Inventions II and I are related as process of making and product made" (see Office Action at paragraph 2). The structural elements of apparatus claim 38 are virtually the same as the structural elements of method claim 18. Hence, Applicants assert that a thorough search for the apparatus and method claims will require search in the same art areas. It is respectfully submitted that examination of Groups I and II together will not require additional searching or undue consideration by the Examiner. Thus, claims of Groups I and II should be combined for examination in a single application.

Objections to the Drawings

In order to address the objections raised to the drawings by the Examiner (see Office Action at paragraph 4), Applicants have proposed amendments to paragraphs [0053] and [0055] of the specification, as shown above. Applicants assert that in light of these amendments no corrections to the drawings are necessary. Accordingly, Applicants respectfully request that the objection be withdrawn.

Claim Objections under 37 C.F.R. 1.75(c)

Claims 2, 3, 6, 9, 11, and 14-17 were objected to under 37 C.F.R. § 1.75(c) as being of improper form for failing to further limit the subject matter of a previous claim. Applicants respectfully traverse the objection. Claims 2, 14, 15 have been canceled. Furthermore, Applicants assert that in light of the features of new independent claims 38 and 60, from which claims 3, 6, 9, 11, 16, and 17 have been amended to depend, and in light of the discussion below, claims 3, 6, 9, 11, 16, and 17 are proper under 37 C.F.R. § 1.75(c). Applicants therefore request that the Examiner reconsider and withdraw the objections to these dependent claims.

Rejections under 35 U.S.C. § 112

Claims 1-17 have been rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regard

as the invention. The Examiner stated that it is not clear what is meant by "outside an outer dimensional profile" in claim 1 and by "outer profile of said heat spreader overlaps with an inner profile" in claim 3 (see Office Action at paragraph 6). Applicants respectfully traverse the rejection.

Claim 1 has been canceled. Hence, the rejection to claim 1 is now moot. Accordingly, Applicants respectfully request that this rejection to claim 1 be withdrawn. Applicants further note that the claim portion referred to as not clear by the Examiner in canceled claim 1 is not recited in new independent claims 38 and 61, in order to more broadly claim the recited subject matter.

The claim portion referred to by the Examiner in claim 3, which recites "outer profile of said heat spreader overlaps with an inner profile" is disclosed in the specification at page 13, paragraph [0062]. An inner dimensional profile 1204 of ring 502 is described in paragraph [0062], and is shown in FIG. 12. An outer dimensional profile 1206 of heat spreader 504 is also described in paragraph [0062], and shown in FIG. 12. As shown in FIG. 12, and described in paragraph [0062], ring 502 and heat spreader 504 may overlap. An example of the overlap between the inner dimensional profile 1204 and the outer dimensional profile 1206 is shown in FIG. 12. The portion of claim 3 that recites "an outer profile of said heat spreader overlaps with an inner profile of said ring shaped stiffener" refers to this overlap. Hence, Applicants assert that in light of at least the portions of the specification referred to above, that claim 3 is sufficiently clear under 35 U.S.C. § 112.

Accordingly, Applicants respectfully request that the rejection to claim 3 be withdrawn.

Rejections under 35 U.S.C. § 102

Claims 1, 4, 5, 6, 8 and 9 have been rejected under 35 U.S.C. 102(a) as being anticipated by U.S. Patent No. 6,163,458 to Li (hereinafter Li). Applicants respectfully traverse the rejections, and request that they be withdrawn.

Applicants note that new independent claim 38 replaces canceled independent claim 1. New independent claim 60 corresponds to originally filed claim 5. Hence, the discussion below will be carried out with respect to new independent claims 38 and 60.

Applicants characterize Li as follows. Li appears to describe a die-down ball grid array package. The ball grid array package of Li includes an IC die 30 mounted in a concavity 12 on the bottom surface of a substrate 10. Solder balls 16 are also attached to the bottom surface of substrate 10. "A metal heat spreader 50 having a protuberance 52 covers on the chip 30. The protuberance 52 contacts the chip 30 to enhance the heat dissipating effect of the chip. The thinner protuberance 52 is formed by punch-pressing the heat spreader 50 to contact the chip 30." (See Li, col 2, line 11-15). Li is very different from the present invention. At least some differences between Li and the present invention are described below, with respect to independent claims 38 and 61.

Technical differences exist between Li and the present invention. The present invention includes a substrate having a plurality of contact pads on a first surface electrically connected through the substrate to a plurality of solder ball pads on a second surface of the substrate. In Li, bonding areas 14 adjoin concavity 12 on the same surface of substrate 10 as solder balls 16 (see Li, col. 2, lines 6-8). This is very different from the present invention. Li does not disclose, teach, or

suggest contact pads on the opposite side of the substrate from attached solder balls. In Li, it would not be possible for a contact pad on the opposite surface of substrate 10 from solder balls 16 to be directly accessed by bonding pads 32 of chip 30. Hence, Li does not disclose, teach, or even suggest a substrate having a plurality of contact pads on a first surface electrically connected through the substrate to a plurality of solder balls pads on a second surface, as recited in independent claims 38 and 60 of the present invention.

Accordingly, Applicants respectfully submit that claims 38 and 60 are patentable over Li for at least the reasons described above. Furthermore, Applicants respectfully submit that claims 4, 5, 6, 8, and 9, and new claims 39-50, which depend from independent claim 38, are likewise patentable over Li. Applicants also respectfully submit that new claims 61-68, which depend from independent claim 60, are patentable over Li. As such, Applicants respectfully request that these rejections be withdrawn.

Rejections under 35 U.S.C. § 103

Claims 2 and 3

Claims 2 and 3 have been rejected under 35 U.S.C. 103 (a) as being unpatentable over U.S. Patent No. 6,163,458 to Li in view of U.S. Patent No. 6,084,777 to Kalidas *et al.* (hereinafter Kalidas). New claim 38 corresponds to canceled claim 2. Applicants respectfully traverse the rejections, and request that they be withdrawn.

As described above, Li does not teach or even suggest all of the subject matter of claim 38. Applicants further submit that Kalidas does not supply the missing teachings of Li. Accordingly,

Applicants respectfully submit that claims 2 and 3, which depend from claim 38, are patentable over Li and Kalidas taken alone or in combination. Applicants therefore request that the Examiner reconsider and withdraw the rejection of claims 2 and 3.

Claims 7, 11, and 12

Claims 7, 11 and 12 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,163,458 to Li in view of the U.S. Patent No. 6,002,169 to Chia *et al.* (hereinafter Chia) (See section 11 of the Office Action letter). Applicants respectfully traverse the rejections, and request that they be withdrawn.

As described above, Li does not teach or even suggest all of the subject matter of claims 6 and 38. Applicants further submit that Chia does not supply the missing teachings of Li. Accordingly, Applicants respectfully submit that claims 7, 11, and 12, which depend from claims 6 and 38, are patentable over Li and Chia taken alone or in combination. Applicants therefore request that the Examiner reconsider and withdraw the rejection of claims 6 and 38.

Furthermore, Applicants respectfully submit that new claim 51, which depends from claim 11, is likewise patentable over Li and Chia. Accordingly, Applicants respectfully request that the Examiner indicate the allowability of this claim.

Claim 10

Claim 10 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,163,458 to Li in view of U.S. Patent No. 5,901,041 to Davies *et al.* (hereinafter Davies) (See

section 12 of the Office Action letter). Applicants respectfully traverse the rejection, and request that it be withdrawn.

As described above, Li does not teach or even suggest all of the subject matter of claim 38. Applicants further submit that Davies does not supply the missing teachings of Li. Accordingly, Applicants respectfully submit that claim 10, which depends from claim 38, is patentable over Li and Davies taken alone or in combination. Applicants therefore request that the Examiner reconsider and withdraw the rejection of claim 10.

Claim 13

Claim 13 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,163,458 to Li in view of U.S. Patent No. 6,002,169 to Chia and U.S. Patent No. 6,166,434 to Desai *et al.* (hereinafter Desai) (See section 13 of the Office Action letter). Applicants respectfully traverse the rejection, and request that it be withdrawn.

As described above, Li and Chia, alone or in combination, do not teach or even suggest all of the subject matter of claim 11. Applicants further submit that Desai does not supply the missing teachings of Li and Chia. Accordingly, Applicants respectfully submit that claim 13, which depends from claim 11, is patentable over Li, Chia, and Desai taken alone or in combination. Applicants therefore request that the Examiner reconsider and withdraw the rejection of claim 13.

Claims 14 and 15

Claims 14 and 15 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,163,458 to Li in view of U.S. Patent No. 6,002,169 to Chia, U.S. Patent 6,166,434

to Desai, and U.S. Patent No. 6,084,777 to Kalidas (See section 14 of the Office Action letter). Claims 14 and 15 have been canceled. The rejection to claims 14 and 15 has been rendered moot. Applicants therefore request that the Examiner withdraw the rejection of claims 14 and 15.

Claim 16

Claim 16 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,163,458 to Li in view of U.S. Patent No. 6,002,169 to Chia, U.S. Patent 6,166,434 to Desai, U.S. Patent No. 6,084,777 to Kalidas, and U.S. Patent No. 5,901,041 to Davies (See section 15 of the Office Action letter). Applicants respectfully traverse the rejection, and request that it be withdrawn.

As described above, Li, Chia, and Desai, alone or in combination, do not teach or even suggest all of the subject matter of claim 13. Applicants further submit that Kalidas and Davies do not supply the missing teachings of Li, Chia, and Desai. Accordingly, Applicants respectfully submit that claim 16, which depends from claim 13, is patentable over Li, Chia, Desai, Kalidas, and Davies, taken alone or in combination. Applicants therefore request that the Examiner reconsider and withdraw the rejection of claim 16.

Furthermore, Applicants respectfully submit that new claims 52-57, which depend from claim 16, are likewise patentable over Li, Chia, Desai, Kalidas, and Davies. Accordingly, Applicants respectfully request that the Examiner indicate the allowability of these claims.

Claim 17

Claim 17 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No.6,163,458 to Li in view of U.S. Patent No. 6,002,169 to Chia, U.S. Patent 6,166,434 to Desai, and U.S. Patent No. 5,901,041 to Davies (See section 16 of the Office Action letter). Applicants respectfully traverse the rejection, and request that it be withdrawn.

As described above, Li, Chia, and Desai, alone or in combination, do not teach or even suggest all of the subject matter of claim 13. Applicants further submit that Davies does not supply the missing teachings of Li, Chia, and Desai. Accordingly, Applicants respectfully submit that claim 17, which depends from claim 13, is patentable over Li, Chia, Desai, and Davies, taken alone or in combination. Applicants therefore request that the Examiner reconsider and withdraw the rejection of claim 17.

Furthermore, Applicants respectfully submit that new claims 58 and 59, which depend from claim 17, are likewise patentable over Li, Chia, Desai, and Davies. Accordingly, Applicants respectfully request that the Examiner indicate the allowability of these claims.

Other Matters

Applicants also note that claims 3, 4, 6-13, 16, 20, and 35 were amended merely to clarify antecedent basis and/or to change dependency from a canceled claim. Therefore, the amendments to claims 3-13, 16, 20, and 35 do not create an estoppel.

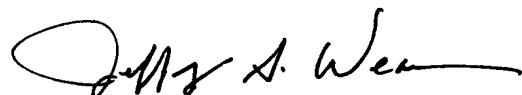
Conclusion

All of the stated grounds of objection and rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider all presently outstanding objections and rejections and that they be withdrawn. Applicants believe that a full and complete reply has been made to the outstanding Office Action and, as such, the present application is in condition for allowance. If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

Prompt and favorable consideration of this Amendment and Reply is respectfully requested.

Respectfully submitted,

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Version with markings to show changes made

[0055] Substrate 104 has a bottom surface to which a top surface of heat spreader 504 is attached by a laminate or adhesive 508. The plurality of solder balls 106 are attached to a bottom surface of substrate 104. The plurality of solder balls 106 connect to vias and/or points on the bottom surface of substrate 104 to which signals internal to substrate 104 are routed and exposed. Substrate 104 in FIG. 5 has a central window-shaped opening 512, which is covered on the bottom surface of substrate 104 by heat spreader 504. FIG. 14 shows a top view of substrate 104 with central window-shaped opening 512. Central window shaped opening 512 [506] accommodates IC die 102 and wire bonds 506. FIG. 12 illustrates a bottom view of a substrate 104, with heat spreader 504 attached. The plurality of solder balls 106 are attached to substrate 104 outside an outer dimensional profile of heat spreader 504.

[0053] FIG. 5 illustrates a cross-sectional view of a portion of a die-up tape BGA package 500, according to an embodiment of the present invention. BGA package 500 includes IC die 102, substrate 104, plurality of solder balls 106, one or more wire bonds 108, encapsulant 116, a stiffener or ring 502, a heat spreader 504, and one or more ground wire bonds 506. FIG. 6 illustrates a top view of die-up tape BGA package 500 (encapsulant [encapsulate] 116 not shown).

3. (Amended) The package of claim [2] 38, wherein an outer profile of said heat spreader overlaps with an inner profile of said [metal] ring shaped stiffener.

4. (Amended) The package of claim [1] 38, wherein said second surface of said heat spreader [surface] is plated with solder that allows said second surface of said heat spreader [surface] to be surface mounted to soldering pads on the PCB.

5. (Amended) The package of claim [1] 38, wherein said substrate has a window opening that is open at said first surface and said second surface of said substrate.

6. (Amended) The package of claim 5, further comprising:
an integrated circuit (IC) die that is mounted to said first surface of said heat spreader [surface] and is accessible through said window opening.

7. (Amended) The package of claim 6, wherein said IC die has a surface that includes a contact pad, wherein said package further comprises:

a wire bond that couples said contact pad to a corresponding metal trace on said first surface of said substrate [surface].

8. (Amended) The package of claim 6, wherein said IC die has a surface that includes a [ground] contact pad, wherein said package further comprises:

a [ground] wire bond that couples said [ground] contact pad to said first surface of said heat spreader [surface].

9. (Amended) The package of claim 8, wherein said second surface of said heat spreader [surface] is coupled to a ground potential of the PCB.

10. (Amended) The package of claim [1] 38, wherein said substrate is a tape substrate.

11. (Amended) The package of claim [1] 38, further comprising:
an integrated circuit (IC) die that is mounted to said first surface of said substrate
[surface].

12. (Amended) The package of claim 11, wherein said IC die has a surface that
includes a contact pad, wherein said package further comprises:
a wire bond that couples said contact pad to a corresponding metal trace on said first
surface of said substrate [surface].

13. (Amended) The package of claim 11, wherein said IC die is mounted to said
first surface of said substrate [surface] in a flip chip configuration, wherein a conductive bump
on an active surface of said IC die is connected to a conductive pad on said first surface of said
substrate [surface].

16. (Amended) The package of claim [14] 13, further comprising:
a second heat spreader attached to a non-active surface of said IC die and [a] said second
surface of said [metal] ring shaped stiffener.

17. (Amended) The package of claim 13, further comprising a via located
proximate to said mounted IC die that extends through said substrate from said first surface of
said substrate to said second surface of said substrate, wherein said via is filled with a
conductive material to couple said conductive bump to said heat spreader.

18. (Amended) A method of assembling a ball grid array (BGA) package,
comprising the steps of:
receiving a substrate having a plurality of contact pads on a first surface electrically
connected through the substrate to a plurality of solder ball pads on a second surface of the
substrate [substrate that has a first surface and a second surface];
attaching a first surface of a heat spreader to the second substrate surface;

attaching a ring shaped stiffener that is centrally open in a first surface and a second surface to the first surface of the substrate;

configuring a second surface of the heat spreader to be coupled to a printed circuit board (PCB); and

attaching a plurality of solder balls to the second substrate surface [outside an outer dimensional profile of the heat spreader].

20. (Amended) The method of claim [19] 18, wherein said heat spreader attaching step comprises the step of:

attaching a first surface of the heat spreader to the second substrate surface, wherein an outer profile of the heat spreader overlaps with an inner profile of the [metal] ring shaped stiffener.

35. (Amended) The method of claim [33] 18, further comprising the step of:
attaching a second heat spreader to a non-active surface of the IC die and a second surface of the [metal] ring shaped stiffener.

Claims 38-68 are new.